

Remarks

Applicants thank the Examiner for the Examiner Interview conducted on November 8, 2004.

Upon entry of the foregoing amendment, claims 1-5 and 8-28 are pending in the application, with claims 1 and 12 being the independent claims. Claims 1-5 and 8-20 are sought to be amended. Claims 6 and 7 are sought to be cancelled without prejudice to or disclaimer of the subject matter recited therein. New claims 21-28 are sought to be added. Independent claims 1 and 12 have been amended to include additional points of clarification that are believed to be allowable in light of the Office Action. Claims 2-5, 8-11, and 13-20 have been amended for further clarification in accordance with the amendments made to the independent claims. These changes are believed to be fully supported by the specification and are not believed to introduce new matter. Applicants therefore respectfully requested that these changes be entered by the Examiner.

Based on the above amendment and the following remarks, Applicants respectfully request that the Examiner reconsider all outstanding objections and rejections and that they be withdrawn.

Objections to the Drawings

On page 2 of the Office Action, the Examiner objected to Figures 9 and 10 as failing to include reference numbers mentioned in the written description. Figures 9 and 10 have been amended herein. In Figure 9, reference numbers "910a", "910b", "910c", and "910d" have been included in accordance with the specification as originally filed. In Figure 10, reference number "1000" has been included in accordance with the specification as originally filed. The proposed changes add no new matter to this

application. Applicants therefore respectfully request that the Examiner reconsider and withdraw the objection.

Objections to the Specification

On page 2, the Office Action requests that the Applicants make the appropriate amendments to the specification to correct the known minor clerical and typographical errors present in the specification. The Office Action directs the Applicants to Patented U.S. Application No. 09/844,266 (Attorney Docket No. 1885.0560005; U.S. Patent No. 6,509,773) having an identical specification wherein corrections have allegedly been made.

Upon review of the prosecution history of Patented U.S. Application No. 09/844,266, Applicants are not aware of any corrections made to its specification. Therefore there are no known minor clerical and typographical errors present in the specification of the instant application. Without further clarification, Applicants cannot make the alleged clerical and typographical corrections. Accordingly, Applicants respectfully request that his objection be reconsidered and withdrawn.

Claim Objections

On page 3, the Office Action states that claims 8-10, 12, and 20 are objected to because they relate to frequency offsets or frequency errors. Specifically, the Office Action alleges that the application is related to the correction of a phase difference between a data signal and the sampling signal used to sample the data signal. The Office Action states that the estimation of a frequency offset in a system for correcting phase

may make the claims indefinite because it becomes unclear if the system corrects phase differences or frequency differences. Applicants respectfully traverse this objection.

Applicants direct the Examiner to section VIII of the specification entitled "Frequency Synchronization" which begins at paragraph 182 on page 39 of the specification. Paragraph 184 of the specification under this section states that "it is desirable for [the sampling signal's] sampling frequency ω_s to match serial data frequency ω_d (for example, such that $\omega_d = n \cdot \omega_s$, where n is an integer greater than zero)." The specification therefore declares that the "timing recovery module of the present invention adjusts sampling frequency ω_s to compensate for the . . . frequency offset $\Delta\omega$ [between sampling frequency ω_s and serial data frequency ω_d], to thereby match the frequency of [the] sampling signal to that of [the] serial data signal."

The remainder of section VIII of the specification describes in detail, for example at paragraph 192, how the present invention "examines changes in [a] phase error signal over time to derive an estimate of a frequency offset, for example, $\Delta\omega$, between serial data signal and sampling signal." Consequently, the application refers repeatedly in section VIII of the specification to the estimation of a frequency offset or a frequency error through examination of a phase offset or a phase error. Therefore, the use of "frequency offset" in the claims properly indicates that the invention is directed to a system or method of frequency synchronization or correction through the intermediate use of a phase error or phase offset. Accordingly, Applicants respectfully request that the Examiner reconsider and withdraw the objection.

Rejections under 35 U.S.C. § 112

On page 3, the Office Action states that claims 1-5, 8-11, and 15 are rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. Regarding claims 1-3, the Office Action specifically states that the specification does not enable one skilled in the art to "rotate the interpolated phase of the sampling signal *at a rate corresponding to the frequency offset.*" Further, the Office Action states that the specification "does not relate to or enable one skilled in the art to modify any frequencies." Applicants respectfully traverse this rejection.

Paragraph 185 of the specification states that the "[i]nterpolated sampling signal has a frequency ω_s (based on reference frequency ω_r) and an interpolated phase ϕ_I ." The specification next states that "since frequency is the derivative of phase (that is, $\omega = d\phi/dt$, where ϕ is phase), [the] interpolator can repetitively rotate interpolated phase ϕ_I through 360° at a predetermined rate to frequency shift sampling frequency ω_s away from the base frequency ω_r ." This enables paragraph 186 of the specification to state that "the sampling frequency ω_s of [the] sampling signal is governed by the equation:

$$\omega_s = \omega_r \pm d\phi_I/dt, \text{ or equivalently}$$

$$\omega_s = \omega_r \pm \Delta\omega_I,$$

where $\Delta\omega_I$ represents the magnitude of the frequency shift away from reference frequency ω_r and $d\phi_I/dt$ represents the rate at which interpolated phase ϕ_I is rotated. Paragraph 187 of the specification therefore concludes that "the present invention can rotate [the] phase ϕ_I of [the] sampling signal at different rates to correspondingly produce different sampling frequencies ω_s ."

Paragraph 190 of the specification describes the function of the phase error processor depicted in Figure 19. The phase error processor includes "a frequency offset

estimator (also referred to as a long-term phase processor)." Paragraph 192 of the specification states that the "frequency estimator integrates phase errors over a relatively long period of time." Specifically, "[f]requency estimator examines changes in [the] phase error signal over time to derive an estimate of a frequency offset, for example, $\Delta\omega$, between [the] serial data signal and [the] sampling signal." Paragraph 91 of the specification states that the "phase error [signal is used] to derive one of a set of rotator control signals or commands."

Paragraph 173 of the specification states that the [p]hase-advance and -retard commands [, (which are two versions of the rotator control signal),] can be implemented as pulsed commands." Further, paragraph 173 of the specification states that "the interpolated phase of [the] sampling signal can be incrementally rotated clockwise or counter-clockwise through a range of 360° by successively pulsing [rotator control signal] commands." Paragraph 173 of the specification continues by stating that "[t]he rate at which the interpolated phase of [the] sampling signal rotates corresponds to the repetition rate of pulsed [rotator control signal] commands." Paragraph 194 of the specification states that rotator control signals are generated "at a repetition rate based on the frequency offset estimate $\Delta\omega$." Paragraph 194 of the specification therefore concludes that "[t]his causes [the] digital control signals and correspondingly the phase of sampling signal to rotate *at a rate based on (for example, equal to) the frequency offset $\Delta\omega$.*"

Based on the forgoing remarks, Applicants have shown that the specification does relate to and does enable one skilled in the art to modify frequencies. Specifically, the specification describes how to adjust the sampling frequency of the sampling signal to match the frequency of the serial data signal. Further, Applicants have shown that the

specification enables one skilled in the art to rotate the interpolated phase of the sampling signal at a rate corresponding to the frequency offset between the serial data signal and the sampling signal in order to achieve frequency synchronization.

Accordingly, Applicants request that the rejection of claims 1-3 be reconsidered and withdrawn

Regarding claims 4 and 15, the Office Action specifically states that the specification "does not enable one skilled in the art *to decrease or increase the frequency of the interpolated sampling signal.*" Further, the Office action states that it is the "phase, not the frequency, that is adjusted by the phase interpolator." Applicants respectfully traverse this rejection.

Paragraph 205 of the specification states that "[t]o decrease [sampling] frequency ω_s relative to reference frequency ω_r (and serial data frequency ω_d) in the present invention, sampling signal phase φ_1 is rotated in the clockwise direction (that is, in the direction of increasing phase) at the necessary rate." The specification next states that "[o]n the other hand, to increase frequency ω_s , phase φ_1 is rotated in the counter-clockwise direction (that is, in the direction of decreasing phase) at the necessary rate (for example, at a rate equal to the frequency offset $\Delta\omega$)."¹ The specification also states that the rotation of the interpolated sampling signal phase is accomplished by the phase interpolator.

Based on the forgoing remarks, Applicants have shown that the specification does relate to and does enable one skilled in the art to increase or decrease the frequency of the interpolated sampling signal. Specifically, the specification describes the adjustment of the sampling signal frequency by rotation of the sampling signal phase by

the phase interpolator. Accordingly, Applicants respectfully request that the rejection of claims 4 and 15 be reconsidered and withdrawn.

Regarding claims 5-11, the Office Action states they are rejected as being based upon a rejected parent claim. Specifically, the Office Action alleges that claims 5-11 depend from rejected claim 1. Applicants respectfully traverse this rejection. For reason stated above with regards to claim 1, the rejection of claim 1 should be withdrawn such that claims 5-11 do not depend from a rejected base claim. Accordingly, Applicants respectfully request the rejection of claims 5-11 be reconsidered and withdrawn.

Rejections under 35 U.S.C. § 102

Claims 1-20 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,002,279 issued to Evans, et al., (hereinafter "Evans"). Applicants respectfully traverse this rejection.

Independent claim 1 has been amended to clarify that the phase interpolator produces both a "data sampling signal and a phase sampling signal each having an interpolated phase responsive to a plurality of phase control signals" such that "the phase sampling signal is offset in phase relative to the data sampling signal by a predetermined amount." This amendment is supported, for example, by paragraphs 87 and 106 of the specification. Independent claim 1 has also been amended to clarify that "a data path . . . sample[s] the serial data signal according to the data sampling signal to produce a data signal [and] a phase path . . . sample[s] the received serial data signal according to the phase sampling signal to produce a phase signal." This amendment is supported, for example, by paragraphs 88 and 89 of the specification.

Further, independent claim 1 has been amended to recite that "a phase detector . . . produce[s] a phase error signal based on the data signal and the phase signal, wherein the phase error signal is indicative of a phase offset between the data sampling signal and the received serial data signal." This amendment is supported, for example, by paragraph 90 of the specification. Independent claim 1 has also been amended to recite that "a phase error processor . . . produce[s] a frequency offset estimate signal based on long-term error processing of the phase error signal." This amendment is supported, for example, by paragraphs 191-194 of the specification.

Independent claim 12 has been amended in accordance with the aforementioned clarifications and features recited in claim 1. Claims 1 and 12, as amended, are not taught or suggested by Evans. Accordingly, Applicants request that the rejection under 35 U.S.C. § 102(e) be reconsidered and withdrawn and that claims 1 and 16 be passed to allowance.

Claims 2-5 and 8-11 depend from independent claim 1 and thus are patentable for at least the reasons provided above with respect to claim 1. Claims 13-20 depend from independent claim 12 and thus are patentable for at least the reasons provided above with respect to claim 12. Applicants therefore request that the rejection of claims 2-5, 8-11, and 13-20 under 35 U.S.C. § 102(e) be reconsidered and withdrawn.

New Claims 21-28

New claims 21-24 depend from amended independent claim 1. New claims 25-28 depend from amended independent claim 12. Support for new claims 21-22 and 25-26 is found, for example, on pages 41-44 of the specification. Support for new claims 23-24 and 27-28 is found, for example, on page 21 of the specification. Claims 21-28

are thus patentable for at least the reasons provided above with respect to claims 1 and 12. Applicants therefore respectfully request prompt consideration and allowance of new claims 21-28.

Conclusion

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider all presently outstanding objections and rejections and that they be withdrawn. Applicants believe that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

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Amendments to the Drawings

Applicants submit herewith two (2) replacement drawing sheets containing proposed corrections to Figures 9 and 10. Please substitute the replacement Figures 9 and 10 for pending Figures 9 and 10. The changes made introduce no new matter and their entry is respectfully requested.